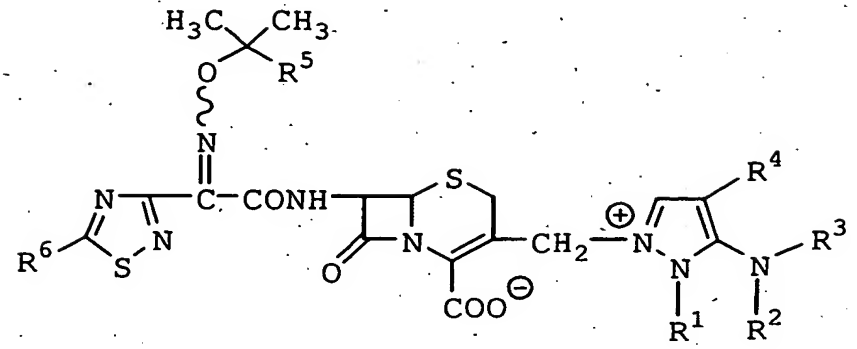
CLAIMS

1. A compound of the formula [I]:



[I]

wherein

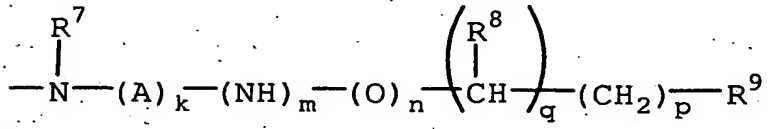
R^1 is lower alkyl, hydroxy(lower)alkyl or halo(lower)alkyl, and

R^2 is hydrogen or amino protecting group, or

R^1 and R^2 are bonded together and form lower alkylene or lower alkenylene;

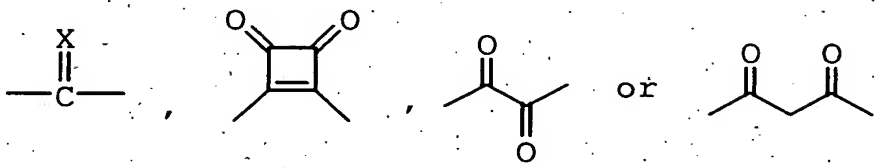
R^3 is hydrogen or lower alkyl;

R^4 is



wherein

A is



wherein X is O or NH,

R^7 is hydrogen, lower alkyl or amino protecting group,

R^8 is hydrogen or hydroxy,

R^9 is amino, mono or di(lower)alkylamino, protected amino, guanidino, protected guanidino or saturated 3- to 8-membered heterocyclic group containing 1 to 4 nitrogen atoms optionally substituted by amino or protected amino,

k, m, n and q are independently 0 or 1, and

p is 0, 1, 2 or 3;

R^5 is carboxy or protected carboxy; and

R^6 is amino or protected amino,

or a pharmaceutically acceptable salt thereof.

2. The compound of claim 1 wherein

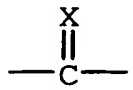
R^1 is lower alkyl or hydroxy(lower)alkyl, and

R^2 is hydrogen or amino protecting group, or

R^1 and R^2 are bonded together and form lower alkylene;

R^3 is hydrogen;

A is



wherein X is O or NH;

R^7 is hydrogen or amino protecting group;

R^9 is amino or protected amino; and

p is 0, 1 or 2,

or a pharmaceutically acceptable salt thereof.

3. The compound of claim 2 wherein R^8 is hydrogen, or a pharmaceutically acceptable salt thereof.

4. The compound of claim 1 wherein

R^1 is lower alkyl, hydroxy(lower)alkyl or halo(lower)alkyl, and

R^2 is hydrogen, aryl(lower)alkyl or acyl, or

R^1 and R^2 are bonded together and form lower alkylene or lower alkenylene;

R^5 is carboxy or esterified carboxy;

R^6 is amino or acylamino;

R^7 is hydrogen, lower alkyl or acyl; and

R^9 is amino, mono or di(lower)alkylamino, acylamino, guanidino, acylguanidino or saturated 3- to 8-membered heterocyclic group containing 1 to 4 nitrogen atoms optionally substituted by amino or acylamino,

or a pharmaceutically acceptable salt thereof.

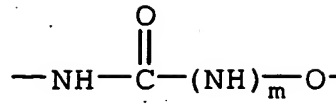
5. The compound of claim 4 wherein
R^1 is lower alkyl or hydroxy(lower)alkyl, and
R^2 is hydrogen, aryl(lower)alkyl or acyl, or
R^1 and R^2 are bonded together and form lower alkylene;
R^5 is carboxy or esterified carboxy;
R^6 is amino or acylamino;
R^7 is hydrogen or acyl; and
R^9 is amino or acylamino,
or a pharmaceutically acceptable salt thereof.

6. The compound of claim 5 wherein
R^1 is lower alkyl or hydroxy(lower)alkyl, and
R^2 is hydrogen, aryl(lower)alkyl, lower alkanoyl or lower alkoxycarbonyl, or
R^1 and R^2 are bonded together and form lower alkylene;
R^5 is carboxy or lower alkoxycarbonyl;
R^6 is amino, lower alkanoylamino or lower alkoxycarbonylamino;
R^7 is hydrogen, lower alkanoyl or lower alkoxycarbonyl; and
R^9 is amino, lower alkanoylamino or lower alkoxycarbonylamino,
or a pharmaceutically acceptable salt thereof.

7. The compound of claim 6 wherein
R^1 is lower alkyl or hydroxy(lower)alkyl, and
R^2 is hydrogen, or
R^1 and R^2 are bonded together and form lower alkylene;
R^5 is carboxy;
R^6 is amino;
R^7 is hydrogen or lower alkanoyl; and
R^9 is amino,
or a pharmaceutically acceptable salt thereof.

8. The compound of claim 1 wherein
R^4 is selected from the group consisting of

$$-NH-A-(NH)_m-(CH_2)_q-(CH_2)_p-R^{14}\quad,$$



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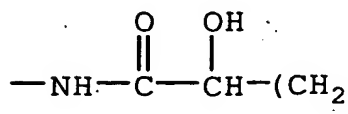

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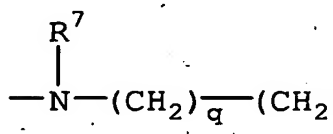

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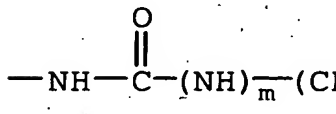

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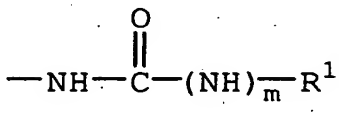
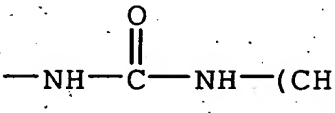


wherein R^7, A, m, p and q are each as defined in claim 1,
R^{14} is amino, mono or di(lower)alkylamino or protected amino,
R^{15} is guanidino or protected guanidino, and
R^{16} is saturated 3- to 8-membered heterocyclic group containing 1 to 4 nitrogen atoms optionally substituted by amino or protected amino,
or a pharmaceutically acceptable salt thereof.

9. The compound of claim 1 wherein
R^4 is selected from the group consisting of



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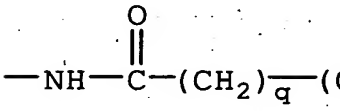

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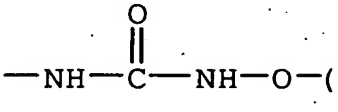

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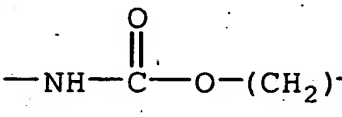

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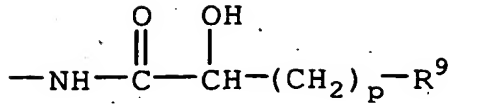

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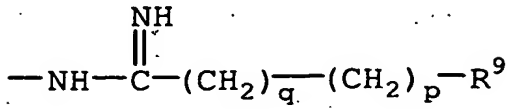
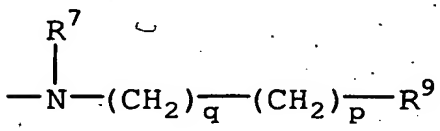


and



wherein

p is 0, 1 or 2,

q is 0 or 1,

R^7 is hydrogen or amino protecting group, and

R^9 is amino or protected amino,

or a pharmaceutically acceptable salt thereof.

10. The compound of claim 9 wherein

R^7 is hydrogen, lower alkanoyl or lower alkoxycarbonyl; and

R^9 is amino, lower alkanoylamino or lower alkoxycarbonylamino,

or a pharmaceutically acceptable salt thereof.

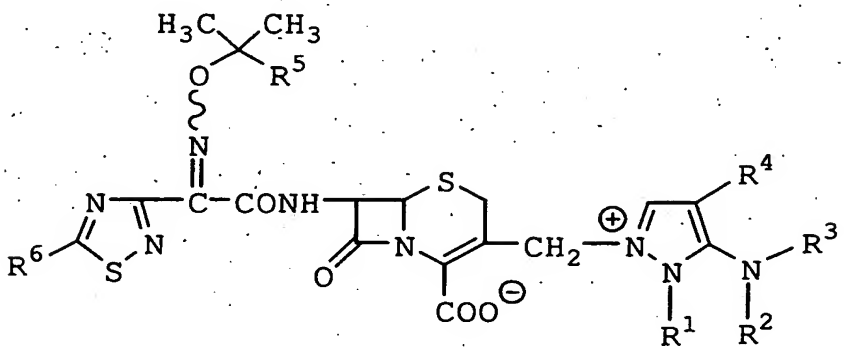
11. The compound of claim 10 wherein

R^7 is hydrogen or lower alkanoyl; and

R^9 is amino,

or a pharmaceutically acceptable salt thereof.

12. A process for preparing a compound of the formula [I]:



[I]

wherein

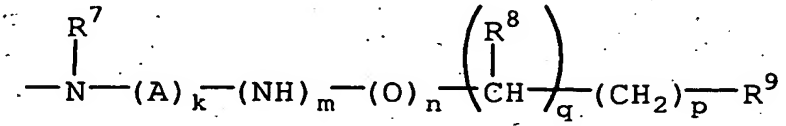
R^1 is lower alkyl, hydroxy(lower)alkyl or halo(lower)alkyl, and

R^2 is hydrogen or amino protecting group, or

R^1 and R^2 are bonded together and form lower alkylene or lower alkenylene;

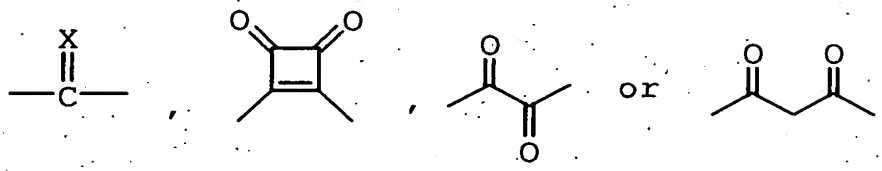
R^3 is hydrogen or lower alkyl;

R^4 is



wherein

A is



wherein X is O or NH,

R^7 is hydrogen, lower alkyl or amino protecting group,

R^8 is hydrogen or hydroxy,

R^9 is amino, mono or di(lower)alkylamino, protected amino, guanidino, protected guanidino or saturated 3- to 8-membered heterocyclic group containing 1 to 4 nitrogen atoms optionally substituted by amino or protected amino,

k, m, n and q are independently 0 or 1, and

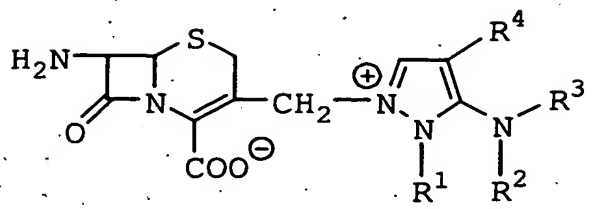
p is 0, 1, 2 or 3;

R^5 is carboxy or protected carboxy; and

R^6 is amino or protected amino,

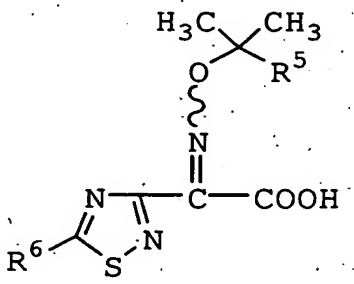
or a salt thereof, which comprises

(1) reacting a compound of the formula [II]:



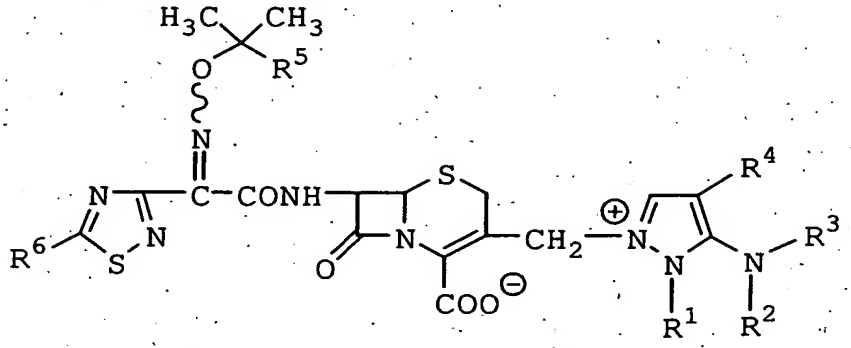
[II]

wherein R^1, R^2, R^3 and R^4 are each as defined above, or its reactive derivative at the amino group, or a salt thereof with a compound of the formula [III]:



[III]

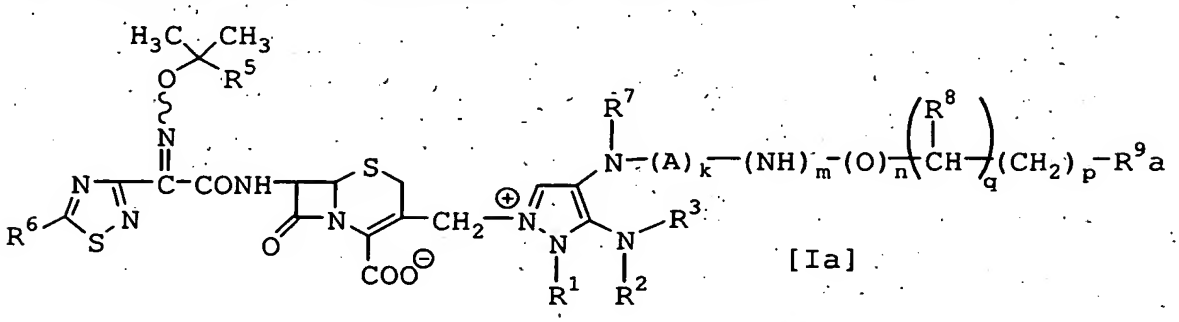
wherein R^5 and R^6 are each as defined above, or its reactive derivative at the carboxy group, or a salt thereof to give a compound of the formula [I]:



[I]

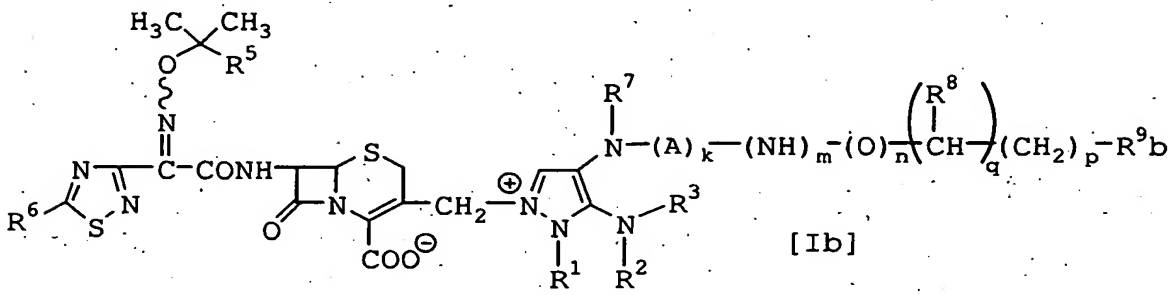
wherein R^1, R^2, R^3, R^4, R^5 and R^6 are each as defined above, or a salt thereof, or

(2) subjecting a compound of the formula [Ia]:



[Ia]

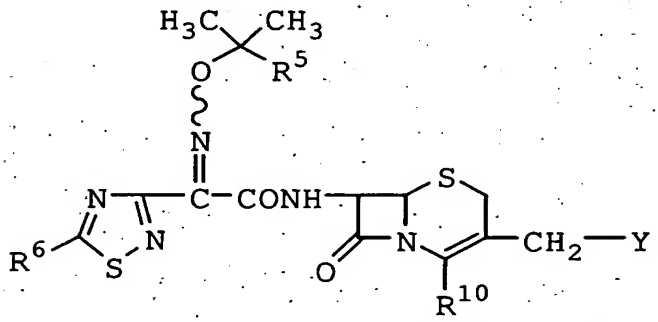
wherein R^1, R^2, R^3, R^5, R^6, R^7, R^8, A, k, m, n, p and q are each as defined above, and R^9a is protected amino, protected guanidino or saturated 3- to 8-membered heterocyclic group containing 1 to 4 nitrogen atoms substituted by protected amino, or a salt thereof to elimination reaction of the amino protecting group to give a compound of the formula [Ib]:



[Ib]

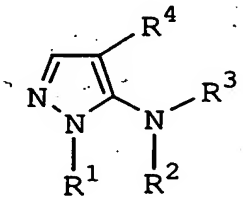
wherein R^1, R^2, R^3, R^5, R^6, R^7, R^8, A, k, m, n, p and q are each as defined above, and R^9b is amino, guanidino or saturated 3- to 8-membered heterocyclic group containing 1 to 4 nitrogen atoms substituted by amino, or a salt thereof, or

(3) reacting a compound of the formula [VI]:



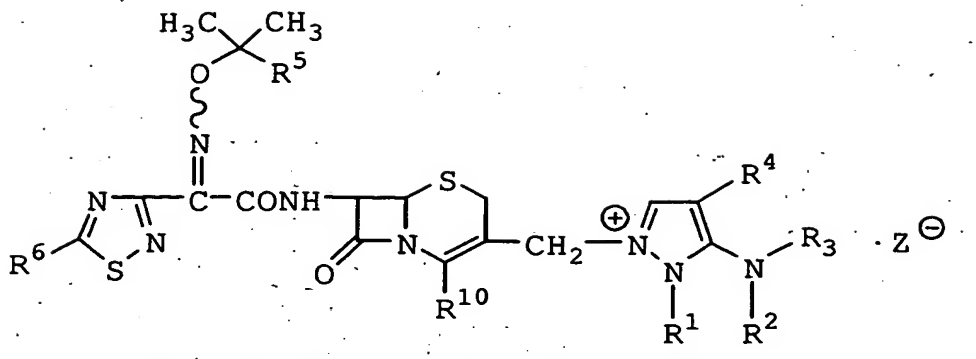
[VI]

wherein R^5 and R^6 are each as defined above, R^{10} is protected carboxy, and Y is a leaving group, or a salt thereof with a compound of the formula [VII]:



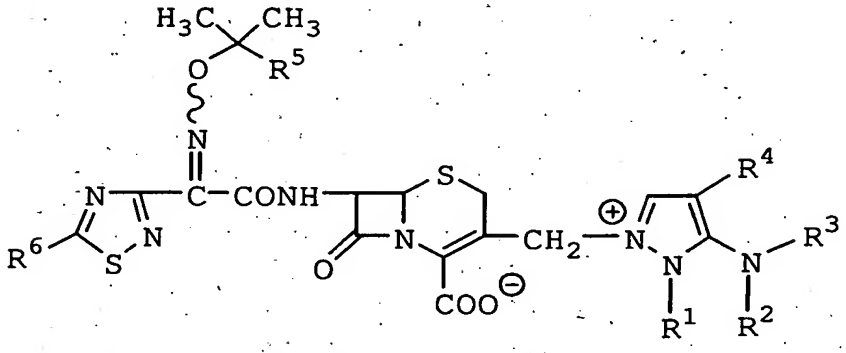
[VII]

wherein R^1, R^2, R^3 and R^4 are each as defined above, or a salt thereof to give a compound of the formula [VIII]:



[VIII]

wherein R^1, R^2, R^3, R^4, R^5, R^6 and R^{10} are each as defined above, and $Z^{\ominus}$ is an anion, or a salt thereof, and subjecting the compound of the formula [VIII] or a salt thereof to elimination reaction of the carboxy protecting group, to give a compound of the formula [I]:



[I]

wherein R^1, R^2, R^3, R^4, R^5 and R^6 are each as defined above, or a salt thereof.

13. A pharmaceutical composition comprising a compound of claim 1 or a pharmaceutically acceptable salt thereof in admixture with a pharmaceutically acceptable carrier.

14. A compound of claim 1 or a pharmaceutically acceptable salt thereof for use as a medicament.

15. A compound of claim 1 or a pharmaceutically acceptable salt thereof for use as an antimicrobial agent.

16. Use of a compound of claim 1 or a pharmaceutically acceptable salt thereof for manufacture of a medicament for treating infectious diseases.

17. A method for the treatment of infectious diseases which comprising administering a compound of claim 1 or a pharmaceutically acceptable salt thereof to human or animals.